Scientific discovery: that-what's and what-that's

By: Samuel Schindler

What is a scientific discovery? T.S. Kuhn (1962b, 1962a) claimed that a discovery always involves not only a discovery-that (the observation of the discovered object) but also a discovery-what (the correct conceptualization of the discovered object); one without the other is insufficient for a discovery. Kuhn also distinguished between two broad classes of discovery: discoveries in which the discovery-that is being made before the discovery-what (one may refer to those discoveries as that-what discoveries), and vice versa, discoveries in which the discovery- what is being made before the discovery-that (what-that discoveries).

Each class of these discoveries comes with distinctive features, whereby the former Kuhn considered the more interesting ones.

This paper will defend Kuhn's distinction between the two types of discovery and their characteristics against alternative accounts of discovery proposed by Achinstein (2001), Hudson (2001), and McArthur (2011). It will be argued that these alternative accounts are inappropriate, in large part, because they have fallen behind Kuhn's insights. Yet there some aspects in Kuhn's account of discovery that are vague. This paper will seek to make these aspects more precise.

For T.S. Kuhn, "discovering a new sort of phenomenon is necessarily a complex event, one which involves recognizing both that something is and what it is" (Kuhn 1996, 55). It would be a mistake, according to Kuhn, to "assimilate" discoveries in science to the (naively construed) act of seeing or to other sense perceptions (ibid.). Rather a discovery, for Kuhn, not only involves the observation of an object, but also the correct conceptualisation of that object. Kuhn's main example for illustrating this point is the discovery of oxygen. Although Joseph Priestley was arguably the first to have isolated oxygen, he did not conceptualise it correctly. Rather, working within the theoretical framework of the phlogiston theory, Priestley thought that he had discovered dephlogisticated air, i.e., air that depleted of phlogiston. Lavoisier, according to Kuhn, can not be said to have discovered oxygen either, because also his conception of oxygen was mistaken: he believed that oxygen gas was a combination of oxygen (i.e., the 'principle' of acidity) combined with caloric, the (non-existent) matter of heat. On the other hand, without the requirement of the correct conceptualisation of the thing discovered, we would have to say that oxygen was discovered by anybody who ever bottled impure oxygen since Priestley himself did not manage to isolate a pure sample of oxygen (54). All we can say then, according to Kuhn, is that oxygen was discovered sometime in the period of 1774 until 1777. More generally, discoveries are "not isolated events, but extended episodes" where it is largely arbitrary to identify any one scientist as the discoverer of a scientific object (ibid., 52).

Interestingly, in a paper published in Science in 1962 (reprinted in 1977), which formed the basis for chapter six of The Structure of Scientific Revolutions (published in the same year), Kuhn made a distinc- tion between two basic kinds of discoveries (which he no longer makes explicitly in The Structure). In one kind of discovery, the conceptualisation is carried out before the object in question is being observed: these are classic cases of prediction, such as the discovery of missing elements in the periodic table, the neutrino, and radio waves (1977, 166-7). But given that that these discoveries were anticipated (usually, but not always, on theoretical grounds), they are "an occasion only for congratulations, not for surprise"; they are thus prime examples for normal science activity, which does

not aim for surprising novelties (Kuhn 1996, 58). In contrast, in discoveries of the second kind, the conceptualisation of the thing discovered usually follows the observation of the thing discovered. Those discoveries may be referred to as that-what discoveries. It is those discoveries that Kuhn considered ”troublesome” and which he made the main focus of chapter six in The Structure.

According to Kuhn, that-what discoveries have sharply distinct characteristics from what-that discoveries.

Whereas what-that discoveries can be instantaneous with regard to the incidence of the discovery-that (1977, 171), only rarely give rise to priority debates (166-7), and where, accordingly, ”only a paucity of data can prevent the historian from ascribing [discoveries] to a particular time and place” (167), the contrary is the case in that-what discoveries. In that-what discoveries (such as in the discovery of oxygen), there necessarily is a time-dimension to discoveries, for it simply takes time to conceptualise a thing for which one had no, or only an inappropriate, conception at the time of observation (1996, 55). The necessary time dimension of that-what discoveries, regularly involving several individuals, is therefore a major reason for why an attribution of a discovery to any one individual is ”often impossible” and to a moment in time is ”always imposssible” (55). In that-what discoveries there are thus ”no benchmarks to inform either the scientist or the historian when the job of a discovery has been done” (1977, 167). Although not all discoveries may fall neatly in either the what-that or the that-what category (ibid., fn on 167), Kuhn clearly thinks that most cases do. Whether that is the case or not will not be decided in this paper. What this paper will confirm, though, is that there are important cases of discovery that are well-captured by Kuhn’s account and in fact much better than by alternative accounts of scientific discovery.

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